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THE IMPORTANCE OF DISCIPLINE IN MINE SAFETY

BY

D. HARRINGTON

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THE IMPORTANCE OF DISCIPLINE IN MINE SAFETY[1]

By D. Harrington[2]

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We Americans fondly believe that ours is the greatest, most progressive and most civilized country in the world, but the cold statistical facts reveal that we apparently have little appreciation for the lives of those whose efforts of various kinds give us whatever greatness we have. The latest available statistics indicate that the annual death rate per 100,000 persons from accidents is nearly 80, or far higher than that of any other country in the world; it is more than double the rate in Denmark, Belgium, Netherlands, France, Sweden, Italy, Ireland, Germany, Norway, and Austria; it is practically double the rate in England and Wales and in Japan, and is from 25 to 60 per cent higher than the corresponding rate in Scotland, New Zealand, Australia, Switzerland, and Canada.

And added to this is the fact that of the main industries of the United States mining has by far the worst accident record, viewed from either the frequency or the severity basis. The National Safety Council's latest figures for 27 of the country's main industries give mining the highest or worst accident frequency rate, 74.43 in 1929; meat packing comes next with 55.94, and construction third with 50.41. In accident severity in 1929 mining also was the worst offender, with a rate of 9.99; quarrying is second with 6.11, and construction third with 4.62.

Metal mining's frequency rate in 1929 was 52.16, as against 69.25 for bituminous coal mining, 99.68 for anthracite mining, and 74.43 for the entire mining industry; accident severity for metal mining in 1929 was 5.99, as against 11.69 for bituminous coal mining, 10.87 for anthracite mining, and 9.99 for the mining industry as a whole. Although this figure indicated that metal mining is on a much safer plane than either bituminous or anthracite coal mining, the frequency rate of 52.16 for metal mining was higher in 1929 than the frequency rate of all but one of the other 26 industries about which data are available; the metal mining severity rate of 5.99, while much better

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2 - Chief engineer, safety division, U. S. Bureau of Mines.

than that of coal mining (bituminous or anthracite), was higher than all but one of the other 26 industries about which accident data are available.

Metal mining's safety record in the United States, in addition to being by no means as bad as that of coal mining, has the encouraging feature that accident rates, especially as to fatalities in metal mining, are being steadily and very definitely reduced as the years go past, though unfortunately this is not true of coal mining. The fatality rate in metal mining per thousand 300-day workers was 4.01 for the 5 years 1911-1915, 3.70 for the 5 years 1916-1920, 3.23 for the 5 years 1921-1925, 3.47 for 1926, 3.10 for 1927, 2.50 for 1928, and 3.03 for 1929. This shows a reduction of about 37½ per cent in fatalities from the 1911-1915 rate to that of 1928, and of about 26 per cent from the 1911-1915 rate to that of 1929. The rates of similar nature and periods involving nonfatal accidents in metal mining are not so favorable, the metal mining rate of nonfatal accidents per thousand 300-day workers being 198.22 for the 5-year period 1911-1915, and 245.01 for 1926, 221.54 for 1927, 205.61 for 1928, and 200.11 for 1929; probably some of the increase in the nonfatal rate in metal mining is due to better and more complete methods of keeping and forwarding accident records during the later years.

With regard to metal mining in the Lake Superior region, the ores yield copper and iron. Copper mining is restricted to Michigan, which produces 7,000,000 to 8,000,000 tons of ore yearly. The workings are deep - some of them more than 5,000 feet. Iron mining is done in Michigan, Minnesota, and Wisconsin, which produced 16,800,000, 46,500,000, and 1,800,000 tons, respectively, in 1929. The workings are underground and open-pit in Michigan and Minnesota, and underground only in Wisconsin.

In 1929 Michigan employed 4,426 men in its copper mines and 2,364 on the surface, a total of 6,790. Of these, 16 were killed underground and two on the surface, while 1,804 were injured inside and 251 outside. At its iron mines 8,835 were employed, 5,874 underground, 2,572 on the surface, and 389 in open pits. Of these, 19 were killed underground; 393 were injured underground, 49 on the surface, and 8 in open pits.

Minnesota employed 3,926 underground, 1,725 on the surface, and 4,855 in open pits, a total of 10,506. Of these, 11 were killed inside, two on the surface, and 16 in open pits; and 374, 57, and 271 were injured, respectively, in the same workings.

Wisconsin had 682 underground and 331 on the surface, a total of 1,013. Of these, two were killed and 23 injured inside, and two injured on the surface.

As to the period 1911-1929, Michigan metal mines killed 1,399 and injured 10,919; Minnesota, 891 and 52,481; Wisconsin 139 and 9,061. The total for the Lake Superior region then is 2,429 killed and 162,461 injured in 19 years; but there has been a large and encouraging decrease in recent years in both fatalities and injuries. One fact shown by these figures is the relative safety of open-pit operations.

There is no question that present-day thought is veering strongly toward the prevention of accidents in all walks of life, including that of industry; and the more the subject of safety is carefully considered and analyzed, the more definite is it established that safe methods, safe practices, safe equipment, etc., are advantageous to employer, employee, and the general public--not only from the altruistic point of view, but also from the more cold-blooded but much more practical one of dollars and cents. Compensation laws are becoming more and yet more liberal to the injured or his dependents. This is as it should be, as there is no question that life and limb are about the most valued possessions of human beings. And there is absolutely no doubt now that the financial or pecuniary cost of industrial accidents is heavy and that it must be borne at least temporarily by the industry with, in many cases, the ultimate placing of the burden upon the consumer. In some forms of industry--and some kinds of mining may be included in this--it is difficult, in fact almost impossible, to pass this burden from the industry to the consumer; in that case about the only protection afforded the industry is that of prevention of accidents, and this will, of course, at least in large part, take care of the now important item of compensation of various kinds for industrial injuries. That cost of accidents is of importance in mining may be inferred from the present thought that the direct and indirect cost of accidents constitutes 10 to 15 per cent of the total cost to the mine operator of putting coal on the railroad cars at the mine; similar figures for metal mining are not available. Inasmuch as expert opinion on safety in industry now almost unanimously agrees that industrial safety is almost wholly a function of the attitude of the industrial operating officials, it is apparent that due to failure of those in charge of the coal mining to do their duty in the curbing of accidents, the industry is suffering an unnecessary tax to the amount of 10 or more per cent of the cost of production; and there is no question that this condition applies, possibly to a somewhat less extent, to metal mining. Since there are relatively few mines, coal or metal, in the United States now making a profit of 10 or more per cent--though many are about "breaking even," and many others are losing as little as 5 per cent--it is apparent that curtailment in the occurrence, hence also in the cost of accidents, may well in many cases result in a black rather than a red balance; and when it is realized that those in charge of our mining organizations have within their own power the curtailment, in fact, almost the elimination, of accidents with simultaneous curtailment of the cost of accidents and in some instances with resultant actual speeding of output and of efficiency as a result of prosecuting the accident prevention work, it is manifestly time for our mine operators to "wake up" to the possibilities of personally and effectively directed accident prevention work.

With the placing of much, and in many instances of practically all, of the burden of the expense of mine accidents on the shoulders of the mine operator by compensation laws, and also with the fact that the problem of protecting the life and limb of workers is now by public opinion largely if not wholly placed on each industry (and present-day thought strongly supports the justice of both of these propositions), industrial organizations are being forced into accident prevention work not only to protect the companies but also the executives, who are engaging in this work to protect themselves personally. The functions of the industrial executives in accident prevention work are becoming numerous and complex; if they are logical in their powers of reasoning, the executives quickly see that before the company can consistently ask or expect the workers to heed the safety suggestions of the company officials, the company and its officials must themselves "put their house in order" by laying down a concrete definite safety program; for mines this includes primarily the adoption of a logical method of mining, the installation of safe mining equipment and practices, the setting forth in definite form (preferably in a printed pamphlet) the company's minimum safety requirements, and the organization of its operating officials into an accident-prevention body. After the company has its own affairs so arranged that it can go to its workers with "clean hands" in the forwarding of a safety program, the real work begins; and this is especially the case in mining.

Notwithstanding the very general opinion that the miner, and especially the old-time miner, is the most competent person to determine what should be done to protect his life and limbs, there is no question that the numerous fallacies in this more or less universal belief are largely responsible for much if not most of the accidents in our mines, as well as for the idea that mining is inherently dangerous and that so long as mining is done not only accidents but many of them must occur and in general they must be severe in their effect. The miner is usually of limited education and of equally limited "breadth of vision" as he reads little or no mining technical literature and attends few if any meetings of mining men; his knowledge is usually only what he has been able to acquire through his own far from extensive personal experience, and even the full effect of this is marred through his lack of ability to interpret the data available to him through that experience. Not only is the miner's fund of mining information by no means great, but usually the lack of breadth of knowledge of safe and efficient mining is further handicapped by his being unduly opinionated, an affliction far too prevalent among miners and one which causes them and their employers much grief, personal, physical and financial. These and numerous other more or less correlated conditions have fairly well convinced thoughtful mine safety men that while the mine operator should be held largely (almost wholly) responsible for safety conditions and results in and around mines, the operator should have a free hand to bring about that maximum safety, the best agencies he will have available being ample efficient supervision and drastic but just discipline. The supervision should be of such nature that a competent supervisory mining official should be in personal contact with every mine worker at his working place several times per day to make certain that the worker does not "take chances," probably the worst besetting sin of mine workers as a class; and the mine officials should have full power to visit disciplinary measures on workmen who are slow to carry suggestions into effect, or who refuse point blank to obey suggestions or orders in connection with safety.

Discipline is defined in a recently published dictionary as "development of the faculties by instruction and exercise"; or it is "training whether physical, mental, or moral"; or it is "training to act in accordance with established rules"; or it is "the subject matter of instruction"; and one definition is "education." All of the above are descriptive of the type of

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"discipline" which should be used very generally by mine officials in trying to achieve safety in mining; and the more usual and by no means as effective definition, "submission to order and chastisement inflicted by way of correcting and training," should be used only in very exceptional instances.

The discipline that should be used when the supervisors find some dangerous condition or practice is that of education, and oddly enough the dictionary says that the word "discipline" comes from a Latin word meaning "learn" as well as from another Latin word meaning "teach"; in other words, in using discipline the mine official who uses it logically should have learned before he tries to teach. This "learning" is a prerequisite of supervisory officials if they are to get anywhere in helping the mines as well as the workers to prevent accidents The day of the hard-boiled metal-mine boss whose main, and in many cases almost only, motto was "rock in the box," whose favorite method of getting maximum quantity of rock supposedly with minimum cost was through his burly fist or through threat of the time check, and who boasted that he had no "book larnin" is long since past in practically all mining organizations which are getting good results in mine safety and which can expect to endure in the present struggle of the survival of the fittest. The successful mine official of the future who supervises mines or parts of mines and who exercises discipline is one who is sufficiently intelligent and well educated to learn not only from his own experience but to draw freely upon the ideas and experiences of others in his own community and also throughout the entire mining and industrial world; hence he must read and must assimilate at least part of what he reads, and in addition he must be able to impart his ideas and the information he has gleaned from other mining men to those under his supervision; he must act as a teacher or educator, and in this his best weapon will be patience and kindly perseverance rather than the club of threats, fists, or the time check used by the militant mine boss of the not very far distant past.

Some relatively few workers will unquestionably resist even the best efforts of the supervisor to convey to them up-to-date ideas and methods in mining; for these the old-time type of discipline must be invoked. If kindly advice or instructions in connection with safety are rejected by the worker, there should be no hesitancy in using the type of discipline to which the mine management is agreed. Some mines give a warning for first offense in the transgressing of safety rules or practice after the worker has been instructed in the right way and fails to follow it; a second offense usually causes a lay-off of about a week or even more, and a third offense, discharge. In some organizations the local supervisor does not have the right of discharge but must refer the offender to the personnel department or to some higher official, and employment may be continued under another boss; this plan works sometimes, as personalities are likely to enter into the relations between worker and supervisor and a change of boss or possibly a change of occupation or of working place brings about harmony. However, when the supervisor feels that the worker is deliberately disobeying safety rules or practice, or is so careless as to endanger his life or the lives of others, he should act promptly and firmly, as there is no question that some workers must be compelled to work safely or they will not do it at all, and it is far better to use even harsh disciplinary methods than to cause accidents due to laxness in the enforcement of safety rules or practices.

Below are some suggestions for organizing the supervisory force so as to maintain the type of discipline to which reference is made in this paper:

1. Every mine, large or small, should have a definite actively and constantly functioning safety organization, preferably with the operating head of the company or the mine taking personal lead at the meetings and with active participation of all bosses and, if possible, with active participation by all surface and underground workers or by committees from them.

One of the functions of the safety organization should be to have some person or persons designated to investigate and report on all accidents, trivial or otherwise, and in every case the cause should be determined if possible and the data from these investigations and reports used to try to prevent other accidents or repetition of those which have occurred. United States Bureau of Mines Information Circular 6066 gives suggestions as to the data to be embodied in the reports on accidents; Information Circular 6045 gives some hints as to the formation of safety organization for coal mines and much of the data are readily applicable to metal mines; also data on metal mine safety organizations are available in United States Bureau of Mines Technical Papers 229 and 452 and in Information Circular 6351.

2. Every mining company, large or small, should educate its workers, including the bosses, in safe and efficient mining practices and methods. One of the fallacies which probably more than any other has contributed to the present unsafety of mining is the almost universally prevalent idea of mining men that the miner of long experience knows how to protect himself. The cold facts are that the usual oldtime miner reads practically nothing on safety or efficiency in mining, and hence knows little or nothing but what he himself has seen or what he has learned from some equally poorly informed miner or boss who has just emerged from the ranks of the miners. United States Bureau of Mines Circular of Information 6054 gives some hints as to methods used by the Phelps Dodge Corporation in its New Mexico coal mines in educating its miners, and the data are largely applicable to metal mining, as the same company has used essentially similar methods in its metal mines with marked success in accident reduction as well as in promoting increased output and decreased cost of output. The safety division of the United States Bureau of Mines has established a list of mining people, chiefly bosses, to whom mimeographed safety literature is forwarded as issued; those who wish to receive this safety literature can do so by applying to the Safety Division, U. S. Bureau of Mines, Washington, D. C. During the fiscal year ending June 30, 1930, 61 pamphlets on various phases of safety work in the mining and allied industries were issued by the United States Bureau of Mines.

3. There should be a supervisory official or boss for about every 25 men, always on the job during the shift to oversee the work and to protect the interests of the company as well as the safety of the employees. This is not an additional cost to the company, as definite experience in many parts of the country in practically all kinds of mines shows that if the supervisory official or boss is properly trained in his work, both as to safety and efficiency, he can much more than save the amount of his wages.

Since there are at least 25 and in some cases 100 or more mine workers for every supervisory official, it is manifestly much easier to give safety education to the officials and have them transmit the information to the other workers than to try to reach the entire working force directly. Here is where intensive supervision and discipline come in - and by discipline is meant not the utilization of "hard-boiled" methods of handling men but rather the establishment of common-sense, up-to-date regulations, seeing that they are transmitted to the men and finally insisting that these regulations be obeyed and without reservation or delay. United States Bureau of Mines Information Circular 6194 has suggestions on safety as affected by supervision and discipline, and Information Circular 6211 also has information pertinent to this topic.

4. Every mine should have in printed form and preferably in a small pamphlet which may be kept in the pocket its minimum safety (and possibly efficiency) requirements, with arrangements for alterations, additions, etc., to the data in the pamphlet from time to time. These rules or regulations should be specific, should conform to the State law but should go far beyond the requirements of the State law (as no State has mine safety laws or regulations which are anything like up-to-date or adequate) and every employee should be compelled to keep thoroughly familiar with these requirements, many progressive companies causing employees to be examined from time to time as to the safety rules and regulations. Every employee (including bosses as well as other workers) is entitled to have definite information as to the minimum safety requirements of the company, and the best-known method of conveying this information and of keeping a continuing permanent record of it is by means of printed (pamphlet) rules or regulations. Hundreds of up-to-date mining companies issue rules in pamphlet form, some of these companies being the Phelps Dodge Corporation, The Cleveland Cliffs Iron Co., the Sloss Sheffield Steel & Iron Co., Tennessee Coal Iron & Railroad Co., United Verde Copper Co., Woodward Iron Co., and Alabama Fuel & Iron Co.

5. An excellent method used by some mining companies to keep employees informed about safety and other requirements or developments is that of addressing to every employee from time to time mimeographed or multigraphed letters signed by the president or general manager or other high official. In some cases these letters are sent to the home of the worker, in other cases they are delivered to him at his working place; this is far more effective than the posting of typewritten letters. Several companies using this system have had very good safety records; however, there were also other safety methods used in addition to the sending of the safety letters. Those interested in this form of safety work can secure more information about it in United States Bureau of Mines Circular of Information 6101.

6. The field force of State or county inspectors of metal mines should be available for the forwarding of an intensive and continuing safety campaign in metal mines, but as a prerequisite these men should be authorized to attend safety meetings both within and outside of the State, such as those of the National Safety Council. In addition, they should be supplied with membership in the National Safety Council or other similar organizations to have available up-to-date data on safety in mining.

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7. One of the cheapest, easiest, and at the same time one of the most effective methods of bringing safety-mindedness to the mining personnel, officials as well as miners, is the giving of training in first aid to the injured to the entire personnel. This training work does not reach anything like its full effectivensss unless every person above and below ground takes it. In the past, or up to about 1926, first-aid training was given to but a relatively few persons at any one mining plant, and this system was fully as ineffective as if but 5 or 10 persons out of every 100 in underground mining were to know how to protect themselves from falling rock or from haulage, explosives, and other types of dangers. With the entire personnel kept trained in first aid, the training becomes valuable in preventing accidents in addition to helping to minimize their ill effects if they should occur.

The training of 100 per cent of the personnel of mining plants was started on a fairly large scale in 1926, the companies supplying aid of some of their employees to the United States Bureau of Mines forces to carry the training through the entire personnel, in some instances as many as 5,000 being trained at one plant. The results are now being made apparent: One mining company with about 2,500 men trained was able the first year after the work was done to complete for the first time in its history a full year without a fatality, the best previous record for any year being eight fatalities; one company having mines with the training and others without it, reports that the accident frequency of the untrained men is eight times as great as those who have had the training; other companies report this rate as 4 or 5 to 1. This work is available essentially without cost to every metal mine, and data as to methods, results, etc., are given in United States Bureau of Mines Circulars 6020 and 6217. The training can be done partly by the United States Bureau of Mines personnel, and there is no good reason why members of the State and county inspection forces and "live wires" in the mine personnel should not aid in quickly making the entire metal mining personnel of the United States trained 100 per cent in methods of giving first aid to the injured.

8. To stimulate safety in mining, safety contests between mines or departments of mines are used to advantage. Also the giving of salary or other type of bonus to bosses whose personnel achieve or excel predetermined safety accomplishments is productive of much good. United States Bureau of Mines Report of Investigations 2617 gives data on bonus systems. Some companies give recognition to individual workers who work stated periods such as 3 months, 6 months, a year or longer without lost-time accidents; one company gives a copper button for 3 months work without a lost-time accident, a silver button for 6 months, and gold button for a year without a lost-time accident. The giving of some sort of reward for safety performances is very much worth while and this is particularly the case where there are in force penalties for infraction of safety rules.

9. Every mining company, large or small, owes it to itself, to its employees, and in a large measure to the public that all prospective employees shall be given a rigid physical examination before being employed, as well as at intervals of not to exceed a year during employment. While mining can be made relatively safe, it is futile to deny that it is a strenuous calling; and persons with defective hearing, eyesight, respiration, and heart

should not be employed in mines, for they are a menace to themselves as well as to their co-workers. It is far more unjust to employ a physically defective person and probably cause him to acquire further and more serious physical deficiencies or possibly to die in a mine or to cause his co-workers to be killed or injured, than it would be to refuse him employment upon learning of the defect or even to relieve him of employment upon his becoming physically defective to such an extent that he endangers himself or others. There is no question that if more care were taken in hiring mine employees (bosses as well as the other workers) and in their instruction upon employment and afterwards, not only safety but also efficiency in mining would be materially increased.

10. Metal mines have been fortunate in having avoided many fire disasters. The word "fortunate" is used advisedly, because the avoidance has been due more to good luck than to any considerable amount of effort on the part of the mining companies, this being largely because metal mining people in general are far too generally of the opinion that mines producing gold, silver, copper, lead, iron, and similar materials have no fire hazard. As a matter of fact, there is probably not a single mine in the United States, metal or coal, which hasn't very definite fire hazards; practically all metal mines use "powder," fuse, timber, and probably other combustibles, all use open lights, and all or practically all allow smoking; many use electricity for pumping or ventilation or haulage or other purpose. Hence, there are almost universally in metal mines the very dangerous combination of combustible material and flame; and very little burning timber or burning explosive can readily produce sufficient poisonous or asphyxiating gases to kill hundreds of persons. Every metal mine should recognize the hazard of fire either in the mine or in the flimsy timber surface structures found so generally at or around the mine opening; and every mine should have a fire prevention and fire fighting plan. The subject is far too extensive to discuss in detail here, but much information about metal mine fires may be secured in United States Bureau of Mines Bulletins 75, 188, and 204, Technical Papers 251, 314, and 363, and Information Circulars 6073 and 6557.

11. The ever-increasing use of electricity in mining introduces many new and serious hazards such as the initiation of fires and accidents from contact of persons with charged electrical installations of various kinds. Utmost care should be taken in the purchasing, installation, use, and maintenance of all electrical equipment or devices in or around mines. At least as frequently as once every month a competent electrician should make a rigid inspection and a written report of the condition of all electrical wiring, machinery, etc., in or around every mine and prompt action should be taken to follow his suggestions in keeping such installations in safe condition at all times. United States Bureau of Mines Information Circulars 6037, 6046, 6052, 6068, 6098, 6100, and 6318 give data concerning safety in the use of electricity in mining.

12. Explosives accidents continue to occur far too frequently in metal mines, and there should be the greatest care in the choice of explosives used and in the storage, transportation, charging, and firing of explosives; only

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such explosive and explosives appurtenances as are of the safest types should be used. In general, electrical blasting is much safer than blasting by fuse, but electrical blasting is by no means "foolproof." If at all feasible, blasting should be done only at the end of the shift, or possibly by shot firers after the general shift has left the mine. Hints on up-to-date blasting are to be found in United States Bureau of Mines Bulletins 287 and 311, Reports of Investigations 2147, 2156, 2789 and 2790, Technical Paper 400, and Information Circulars 6043, 6056, and 6189.

13. Many mining companies are now making remarkable progress in accident prevention through use of protective clothing such as hard hats, various kinds of hard-toed shoes and other foot and leg protection, goggles, safety belts, etc. In many cases difficulty has been encountered in securing the cooperation of the workers, but usually this reluctance can be overcome if the mine officials will pave the way by themselves using the recommended materials consistently. In some cases it has been found necessary to require the use of the protective clothing, but where good judgment is used, compulsion should not be necessary, except possibly for a relatively few persons.

14. Consistence on the part of the mining companies demands that before asking or requiring the employees to alter the old for the newer and safer practices, the companies first "put their house in order." This means that mines should be well ventilated, preferably by mechanical control; that well-constructed cages or man cars be supplied to transport the men into or out of the mine; that all mines have more than one exit, and that all exits have well-placed and well-constructed fire doors for use in case of necessity; that all cages have practical and workable doors which are used at all times when men are aboard; that all of the openings to shafts, winzes, raises, or steep inclines have adequate doors or other device to prevent falling of men or material into them; that ladderways in shafts, raises, or winzes over 70° pitch have platforms at intervals of at least every 30 feet, and that ladders and ladderways be kept clean and in good repair; that all machinery is kept adequately guarded; that timber supply is ample, of correct size, length, etc., and placed reasonably close to the point of use.

There is now no question that mines can be operated essentially as safely as most of the other lines of industrial endeavor, and there is good reason to believe that safe operation is also economical and efficient operation. However, to bring about this safety will require the expenditure of much personal thought, time, and effort, not only by those who actually go into the mines to do the various kinds of work but also on the part of those who control the mine policies. Here is another case where "in union there is strength," and if the right kind of cooperation is kept in effect, it is certain that the desired results will also be forthcoming in lowered accident rate with correspondingly decreased compensation and kindred costs and also in decreased suffering to the minersand their families. In the accomplishing of these very desirable results there is no question that intensive supervision and well-directed discipline are dominant factors; and the type of discipline most likely to produce results of the right kind is that by which the supervisor conveys in one manner or other to the workers the correct, safe, and efficient manner of doing mine work.